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RECIPROCATING COMPRESSOR

RELATED APPLICATIONS

The present disclosure relates to subject matter contained in Korean Application No. 2002-0053586, filed on September 5, 2002, which is herein expressly incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a reciprocating compressor, and particularly, to a reciprocating compressor which increases a compression performance by improving the structures of a suction valve for controlling gas suction and a discharge valve for controlling gas discharge.

2. Description of the Background Art

Generally, a compressor is an instrument for compressing a refrigerant gas under conditions of low temperature and pressure, which is introduced from an evaporator and discharging the gas by changing the conditions to high temperature and pressure.

Compressors can be classified as a rotary compressor, reciprocating compressor and a scroll compressor according to the method of compressing the fluid.

Particularly, the reciprocating compressor takes-in and compresses fluid while a piston moves linearly, and such reciprocating compressor is divided into a method (and device) which compresses fluid by converting the rotary movement

of a driving motor into a reciprocating movement of the piston, and a method (and device) which takes-in and compresses fluid by having the piston perform a reciprocating movement as the driving motor performs a linear reciprocating movement.

Figure 1 is a cross-sectional view showing a conventional reciprocating compressor, Figure 2 is a partially cross-sectional view showing an operation state of a suction valve and a discharge valve in performing gas suction in Figure 1, and Figure 3 is a partially cross-sectional view showing an operation state of the suction valve and the discharge valve in performing gas discharge in Figure 1.

As shown in the drawing, the conventional reciprocating compressor includes a case 10 having a gas suction pipe SP and gas discharge pipe DP, a frame unit 20 which is elastically installed inside the case 10, a reciprocating motor 30 for generating a driving force while fixed to the frame unit 20, a compression unit 40 for sucking, compressing and discharging gas by using a linear reciprocating force of the reciprocating motor 30, and a resonance spring unit 50 for inducing resonating movement by elastically supporting the compression unit 40 in the movement direction.

The reciprocating motor 30 includes an outer stator 31 which is installed between the middle frame 22 and rear frame 23, an inner stator 32 which is secured or coupled to the outer stator 31 at a predetermined spacing and is inserted and secured or coupled with the rear frame 23, and a movable element 33 which is installed between the outer stator 31 and inner stator 32 for performing a linear reciprocating movement.

The compression unit 40 includes a cylinder 41 which is integrally formed in the front frame 21, a piston 42 which is coupled with the movable element 33 of the reciprocating motor 30 for performing a reciprocating movement in a compression space P1 of the cylinder 41, a suction valve 43 which is mounted at the front end of the piston 42 for controlling suction of gas by opening and closing the suction path F of the piston 42, and a discharging valve assembly 70 which is mounted at the discharging side of the cylinder 41 for controlling discharge of compression gas by opening and closing the compression space P1.

The discharging valve assembly 70 includes a discharging cover 71 for covering a side of the cylinder 41, a discharging valve 72 which is inserted inside the discharging cover 71 for opening and closing the compression space P1 of the cylinder 41, and a valve spring 73 installed at the inner side of the discharging cover 71 for elastically supporting the discharging valve 72.

An insertion groove 72b is formed at a pressure supporting surface 72a, that is, a rear surface of the discharge valve 72, and a head of a bolt B which fixed to the suction valve 43protrudes therefrom. Accordingly, the head of the bolt is constructed to be inserted to the insertion groove 72b at the time of driving gas compression.

The operating process of the conventional reciprocating compressor with the above construction will be described as follows.

When a flux is generated between the outer stator 31 and inner stator 32 by applying a power source to the reciprocating motor 30, the movable element 33 of the reciprocating motor 3 elastically performs a reciprocating movement against the resonance spring unit 50.

At this time, as the piston 42 performs a reciprocating movement inside the cylinder 41, the volume of the compression space P1 is changed, and the gas is taken-in and compressed.

As the pressure of the gas is higher than a predetermined pressure, when it becomes higher than an elastic force of the valve spring 73, the discharging valve 72 is moved. As the sequential process that the compression gas is discharged into the compression space P2 is repeated, gas is discharged by opening and closing of the discharging valve 72 is discharged to the outside through a gas discharging pipe DP which is formed in the discharging cover 71.

Hereinafter, referring to Figures 2 and 3, processes for taking-in, compressing, and discharging gas will be explained.

As shown in Figure 2, when the piston 42 moves to a lower dead point (a), the discharge valve 72 of the discharging valve assembly 70 contacts an end portion of the cylinder 41 by a pressure difference, thereby closing the compression space P1.

At the same time, the suction valve 43 engaged to the piston 42 is bent and opens the suction path F, so that refrigerant gas is sucked in the compression space P1 of the cylinder 41 through the suction path F of the piston 42.

As shown in Figure 3, the piston 42 moves to an upper dead point (b) after reaching to the lower dead point a, the suction valve 43 returns to an initial state and the suction path F is closed, thereby compressing the refrigerant gas sucked in the compression space P1 of the cylinder 41.

As the pressure of the gas is higher than a predetermined pressure, when it becomes higher than an elastic force of the valve spring 73, the discharge valve 72

of the discharging valve assembly 70 is opened, thereby discharging the compressed refrigerant gas.

However, in the conventional compressor, the discharge valve 72 supported by the valve spring 73 does not move horizontally in the gas compression process, but moves in a slanted state.

That is because the valve spring 73 hardly has a horizontal disposition in a structure.

As aforementioned, when the discharge valve 72 moves in a slanted state not a horizontal state, the head (especially, an angular portion) of the bolt B is not inserted to the insertion groove 72b but contacts the adjacent portions or pressurized, thereby destroying the discharge valve and increasing the compression space. According to this, a dead volume is generated which serves to degrade a compression performance.

Also, in the conventional compressor, since the suction path is not formed at the center of the piston, gas is discharged without balance.

SUMMARY OF THE INVENTION

Therefore, an object of the present invention is to provide a reciprocating compressor which increases a compression performance by improving the structures of a suction valve for controlling gas suction and a discharge valve for controlling gas discharge.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a reciprocating compressor comprising: a piston which reciprocates in a

cylinder by receiving a driving force of a reciprocating motor and has a gas suction path therein; a suction valve mounted at an end surface of the piston to control flow of gas taken-in through the suction path; a valve assembly having a discharge cover engaged to one side of the cylinder, a discharge valve installed at an end portion of the cylinder to control gas discharge of a compression space formed by the cylinder and the piston, and a valve spring that elastically supports the discharge valve; and a suction valve fixing member engaged to a frontal surface of the piston that movably receives the suction valve back and forth.

The suction valve is provided with supporting surfaces at the outer circumference thereof, and suction surfaces that pass gas are formed between the supporting surfaces.

The suction valve fixing member is provided with a through hole connected to the suction path at a center of the frontal surface thereof.

A protrusion surface is formed at a center of the rear surface of the discharge valve to correspond to the through hole.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is also provided a reciprocating compressor comprising: a piston which reciprocates in a cylinder by receiving a driving force of a reciprocating motor and has a gas suction path therein; a suction valve mounted at an end surface of the piston to control flow of gas taken-in through the suction path; a valve assembly having a discharge cover engaged to one side of the cylinder, a discharge valve installed at an end portion of the cylinder to control gas discharge of a compression space

formed by the cylinder and the piston, and a valve spring that elastically supports the discharge valve; a round head rivet that fixes the suction valve to the piston; and an insertion groove formed at the rear surface of the discharge valve to insert the round head rivet.

The foregoing and other objects, features, aspects and advantages of the present invention will become more apparent from the following detailed description of the present invention when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

In the drawings:

Figure 1 is a sectional view of the conventional reciprocating compressor;

Figure 2 is a partially cross-sectional view showing an operation state of the discharge valve assembly in operating suction of gas in the compressor of Figure 1;

Figure 3 is a partially cross-sectional view showing an operation state of the discharge valve assembly in operating discharge of gas in the compressor of Figure 1;

Figure 4 is a longitudinal sectional view showing a reciprocating compressor according to one preferred embodiment of the present invention;

Figure 5 is a partially cross-sectional view showing an operation state of the discharge valve assembly in operating suction of gas in the compressor of Figure 4;

Figure 6 is a partially cross-sectional view showing an operation state of the discharge valve assembly in operating discharge of gas in the compressor of Figure 4;

Figure 7 is a disassembled perspective view showing an engagement mechanism of the suction valve and the piston;

Figure 8 is a disassembled perspective view showing another engagement mechanism of the suction valve and the piston;

Figure 9 is a frontal view showing a suction valve fixing member of the compressor of Figure 4; and

Figures 10 and 11 show a part of the reciprocating compressor according to another preferred embodiment of the present invention, wherein

Figure 10 is a longitudinal sectional view showing an operation state of the discharge valve assembly in suctioning gas; and

Figure 11 is a longitudinal sectional view showing an operation state of the discharge valve assembly in compressing gas.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

A reciprocating compressor according to the present invention will be explained with reference to the attached drawings.

Figure 4 is a longitudinal sectional view showing a reciprocating compressor according to one preferred embodiment of the present invention, Figure 5 is a partially cross-sectional view showing an operation state of the discharge valve assembly in operating suction of gas in the compressor Figure 4, Figure 6 is a partially cross-sectional view showing an operation state of the discharge valve assembly in operating discharge of gas in the compressor Figure 4, Figure 7 is a disassembled perspective view showing an engagement mechanism of the suction valve and the piston, Figure 8 is a disassembled perspective view showing another engagement mechanism of the suction valve and the piston, and Figure 9 is a frontal view showing a suction valve fixing member of the compressor Figure 4.

As shown, a reciprocating compressor according to one preferred embodiment of the present invention comprises: a case 10 having a gas suction pipe SP and gas discharge pipe DP; a frame unit 20 installed in the case 10; a reciprocating motor 30 having a movable element which moves linearly; a piston 142 which reciprocates in the cylinder 141 by being connected to the movable element and has a gas suction path F therein; a suction valve 143 mounted at an end surface of the piston 142 for controlling a flow of gas sucked through the suction path F; a valve assembly 170 for controlling a discharge of compressed gas; and a suction valve fixing member 144 engaged to the frontal surface of the piston 142 for movably receiving the suction valve 143 as it moves back and forth.

The discharging valve assembly 170 includes a discharge cover 171 having a predetermined shape and formed to cover one side of the cylinder 141, a discharge valve 172 inserted to the inner portion of the discharge cover 171 for

opening and closing the compression space P1 of the cylinder 141; and a valve spring 173 supported on the inner side of the discharge cover 171 and engaged to the discharge valve 172 for elastically supporting the discharge valve 172 while setting the position of the discharge valve 172.

In said one preferred embodiment of the present invention, a suction valve fixing member 144 is engaged to a frontal surface of the piston 142 with a predetermined spacing in order to movably receive the suction valve 143 as it moves backward and forward, and a connection hole H connected to the suction path F is formed at a center of the frontal surface of the suction valve fixing member 144. A dead volume preventing surface 172a protrudes from a center of the rear surface of the discharge valve 172 corresponding to the connection hole H.

In more detail, the suction valve fixing member 144 having a cylindrical shape includes a cylindrical body 144b engaged to the piston 142, and a stopping portion 144a extending traversely from the end portion surface of the body 144b for restricting the movement of the suction valve 143.

As shown in Figure 7, when the suction valve fixing member 144 is engaged to the piston 142, the suction valve fixing member 144 can be forcibly fit to a frontal side of the piston 142.

Also, as shown in Figure 8, the suction valve fixing member 144 can be engaged to the piston 142 by a male screw S1 formed in front of the piston 142 and a female screw S2 formed at the inner circumferential surface of the suction valve fixing member 144.

The suction valve is formed as a thin plate and can include any components which are smoothly operated when gas is taken-in and compressed.

The suction valve 143 opens the suction path F at the time when gas is taken in, and closes the suction path F at the time when gas is compressed. The suction valve 143 includes a supporting surface 143b at an outer circumference and a suction surface 143a formed between the supporting surfaces 143b to pass gas.

That is, the supporting surface 143b is stopped by the stopping portion 144a of the suction valve fixing member 144, and the suction surface 143a opens the suction path F of the piston 142 when operating to take-in gas and closes the connection hole H of the suction valve 143 when operating in compression of gas.

Operation of the reciprocating compressor according to one preferred embodiment of the present invention will be explained.

When the piston 142 moves to the lower dead point (a) by receiving a driving force of the reciprocating motor 30, gas sucked to the suction path F pushes the suction valve 143 by a pressure difference.

At this time, the suction valve 143 installed at an inner surface of the suction valve fixing member 144 moves backward and thereby opens the suction path F. At the same time, gas which passed the suction path F passes the suction surface 143a of the suction valve 143 to pass the connection hole H, thereby being introduced to the compression space P1.

When the suction operation of gas is completed, the piston 142 goes forward, due to the action of the reciprocating motor 30. At this time, the suction valve 143 goes back by the pressure difference and closes the suction path F of the piston 142.

As the piston 142 reaches to the upper dead point (b) and the pressure of the gas is higher than a predetermined pressure, when it becomes higher than an elastic force of the valve spring 173, the discharging valve 72 is moved and the gas is discharged.

Also, when the compressed gas of the compression space P1 moves to the discharge space P2 and thereby a pressure of the compression space P1 becomes lower than a predetermined pressure, the discharge valve 172 returns to the initial state by the elastic force of the valve spring 173 and the sequential process of the gas being taken in and compressed is repeated.

In the first embodiment of the present invention, even if the discharge valve 172 moves in a slanted state, the dead volume preventing surface 172a of the discharge valve 172 is inserted to the connection hole H of the suction valve fixing member 144, thereby preventing components from coming into contact and preventing a collision from occurring and minimizing the dead volume.

Also, since the suction path F is formed at the center of the piston 142, gas is uniformly discharged, thereby not causing mass unbalance.

Figures 10 and 11 show a part of the reciprocating compressor according to another preferred embodiment of the present invention, wherein Figure 10 is a longitudinal sectional view showing an operation state of the discharge valve assembly in performing gas suction and Figure 11 is a longitudinal sectional view showing an operation state of the discharge valve assembly during gas compression.

As shown, in another embodiment of the present invention, there is still provided a reciprocating compressor comprising: a case 10 having a gas suction

pipe SP and gas discharge pipe DP; a frame unit 20 installed in the case 10; a reciprocating motor 30 having a movable element which linearly moves; a piston 242 which reciprocates in the cylinder 241 by being connected to the movable element and has a gas suction path F therein; a suction valve 243 mounted at an end surface of the piston 242 for controlling a flow of sucked gas through the suction path F; a valve assembly 270 for controlling a discharge of compressed gas; a round head rivet R for fixing the suction valve 243 to the piston 242; and an insertion groove 272b formed at the rear surface of the discharge valve 272 for inserting the round head rivet R.

The discharging valve assembly 270 includes a discharge cover 271 having a predetermined shape and formed to cover one side of the cylinder 241, a discharge valve 272 inserted to the inner portion of the discharge cover 271 for opening and closing the compression space P1 of the cylinder 241; and a valve spring 273 supported on the inner side of the discharge cover 271 and engaged to the discharge valve 272 for elastically supporting the discharge valve 272 while setting or defining the position of the discharge valve 272.

When the gas is compressed, an insertion groove 272b is formed at the rear surface of the discharge valve 272 in order to receive the round head rivet R.

In another embodiment of the present invention, when the piston 242 moves to the lower dead point (a) by receiving a driving force of the reciprocating motor 30, gas sucked to the suction path F pushes the suction valve 243 due to a pressure difference.

At this time, the suction valve 243 goes backward and thereby opens the suction path F. At the same time, gas which passed the suction path F is introduced

to the compression space P1.

When the suction operation of gas is completed, the piston 242 goes forward by receiving a driving force of the reciprocating motor 30. At this time, the suction valve 243 goes back by the pressure difference and closes the suction path F of the piston 242.

As the piston 242 reaches to the upper dead point (b) and the pressure of the gas is higher than a predetermined pressure, when it becomes higher than an elastic force of the valve spring 273, the discharging valve 272 is moved and the gas is discharged.

Also, when the compressed gas of the compression space P1 moves to the discharge space P2 and thereby a pressure of the compression space P1 becomes lower than a predetermined pressure, the discharge valve 272 returns to the initial state by the elastic force of the valve spring 273 and the sequential process by which gas is sucked and compressed is repeated.

In the another embodiment of the present invention, even if the discharge valve 272 moves in a slanted state at the time of gas compression, the round head rivet R is inserted to the insertion groove 272b.

Accordingly, since the round rivet R does not contact or collide with the rear surface of the discharge valve 272, the components are prevented from being damaged and the dead volume is minimized, thereby improving a compression performance.

As aforementioned, in the present invention, damage of the construction components by the collision with the discharge valve are prevented in operating

compression of gas and the dead volume is minimized, thereby improving the compression performance of the compressor.

Also, since the suction path is formed at the center of the piston, gas is uniformly discharged, thereby not causing mass unbalance.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the metes and bounds of the claims, or equivalence of such metes and bounds are therefore intended to be embraced by the appended claims.